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ABSTRACT

Instruction of large groups of students in the use of audiovisual (AV) equipment presents a problem when the students' performance can only be evaluated by individual examinations on actual equipment. An attempt was made, therefore, to develop an objective, paper-and-pencil test which would provide the same evaluation. Although students in a basic instructional materials course improved their scores on the objective test between pretest and posttest, the correlations between scores on the objective test and a performance test were very low, even though the correlation was significant for female subjects considered alone. While this attempt to develop an objective test of competence with audiovisual equipment failed, future research might be more successful if care is taken to preserve the normal motivation of the student subjects. (RH)

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EXPERIMENTAL DESIGN OF AN OBJECTIVE VERBAL-PICTORIAL TEST FOR AUDIOVISUAL EQUIPMENT OPERATIONS SKILLS

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EXPERIMENTAL DESIGN OF AN OBJECTIVE VERBAL-PICTORIAL TEST FOR AUDIOVISUAL EQUIPMENT OPERATIONS SKILLS

PROBLEM

The object of all education is to affect some change in students. To justify education it is necessary to evaluate students in relation to stated objectives. Paper and pencil tests are assumed to be adequate in most academic situations for testing conceptual ability. However, to evaluate a psychomotor skill it has traditionally been considered necessary to test by observing the performance of the skill. The project reported here was an attempt to test the validity of this assumption.

A basic Instructional Materials course was required for Illinois teacher certification. Consequently all education majors enrolled in the basic integrated IM-AV course. One of the objectives of this course was to have the students become reasonably proficient in the operation of the traditional audiovisual equipment. Between 250 and 325 students per quarter registered for this course which made the traditional method of machine operation instruction entirely inadequate. A special laboratory was equipped and staffed so that students could learn this skill as an outside assignment. Time was provided for additional practice when necessary with a trained machine instructor available to give individual help. This arrangement proved quite satisfactory for the students because it gave them flexibility and adequate time to learn the task to an established criterion. From the instructor's point of view however, it was found that a great deal of time was devoted to the administration of the criterion test. A need existed therefore, for an adequate, but less time consuming, test to substitute for the observer administered test.

It was assumed that an adequate substitute test would have the following attributes and advantages:

(1) Test administration would be standardized and not subject to the vagaries and personal feelings of an observer.

(2) Grading would be standardized so personality factors would be eliminated.

Data for this study was collected while the author was on the faculty of the Instructional Materials Department, College of Education, Southern Illinois University, Carbondale, Illinois, and was supported by a grant from the OFFICE OF RESEARCH AND PROJECTS of that institution.

Data reported in this paper were processed at the University of Connecticut Computer Center and supported by NSF Grant GP-1819.

(3) Large groups of students could be given the test simultaneously, thus releasing the instructor for other tasks.

(4) The test could be used to identify individuals who already possess adequate machine operation skill and therefore do not need training.

It was hypothesized that the operation of a motion picture projector, or any machine, depended in part on perception. It was further hypothesized that if the student was able to operate the equipment he would be able to recognize or perceive from a photograph the critical points at which the film and the machine were inconsistent. The purpose of this experimental design was to test the hypothesis that there would be a correlation between a student's ability to perceive a correctly functioning machine from an iconic representation and his score on a performance test. A 16mm motion picture projector was chosen for use because it is perceptually the most complex piece of audiovisual equipment. In addition this was a pilot study to explore the problems involved in producing such a test.

RELATED RESEARCH

Cronbach (2) cites a study by the Navy in which one of two forms of a test (words alone and pictures supplemented by words) was given to gun crews to evaluate the training of gunners. The questions were related to parts of the guns, duties of the crew, appearance of tracer paths and other items which could be visualized. Pictorial test results were found to have a correlation of .90 with the instructors' marks based on gun operations while the correlation of the verbal test with instructors' marks was only .62. It would seem probable from this study that a pictorial test could be constructed which would adequately correlate with an outside criterion. Questions here dealt with items which could be visualized and the results indicated that words alone were inadequate to elicit the desired responses.

Williams (5) on the other hand found that neither the verbal nor the verbal-pictorial test used in his study correlated better with the outside criterion the instructor assigned rank. He did report however that the verbal-pictorial test gave significantly higher scores. The outside criterion in this case was the quality of products produced by the student rather than ability to use the equipment properly. It is possible to speculate that the test and the criterion required different abilities.

Brown and DeKieffer (1) report in a more general article that their technique for presenting a biology examination by photographic slides had seven different advantages. Their prime interest was that the slide test overcame unsatisfactory features of usual biology examinations where students are required to move from station to station. Of most importance to this study is their report that the flexibility and ease of administering the test were much greater than the traditional test. They found the use of slides in biology examinations had advantages for both student and instructor.

Lefkowith (3) found that as the iconicity level of the pictorial stimuli used to test came closer to the iconicity level of the pictorial stimuli used to teach, scores on the tests increased. He also noted that as pictorial stimuli used to test became more iconic the correlation between the subjects' scores on that method and their scores on an equipment test became higher. In addition, he stated it was demonstrated empirically that the pictorial tests were both valid and reliable enough to be used in actual testing programs. This supports the hypothesis that a properly constructed visual test is a practical possibility.

Thelen (4) hypothesized that using motion pictures to test a time dimension and using stereoscopic and color pictures in some cases would increase the realism and therefore validity of a test. While this is an interesting supposition, for purposes of this study it was felt that it would be impractical to administer projected group tests using color slides because of crowded classrooms. Since this study was an attempt to demonstrate the practicability of a testing method it was decided that colored photographs would be too expensive to print in quantity. Therefore black and white printed photographs were used.

Although research related to pictorial testing is meager and the results are unclear, it appeared possible to construct a practical pictorial test which would eliminate the time consuming observer rating technique generally employed to test psychomotor ability. Two hypotheses were selected for study.

Hypothesis 1: The correlation between the verbal-pictorial paper and pencil test will correlate .70 or better with a check sheet criterion test.

Hypothesis 2: There will be a significant difference between the means of the verbal-pictorial paper and pencil test scores when administered as a pre-test and as a post-test to the same individuals.

METHOD

An operations check sheet (Appendix A) was constructed to yield a score which would reflect the ability of student subjects to operate a Bell and Howell Model 385 motion picture projector. Each item in the process was weighted so the final check sheet was sensitive to major and minor errors in the operation process.

A series of photographs were then taken of the Bell and Howell 385 and a pilot study was conducted to select the types of items to be used in the final pictorial test. Samples of the chosen items are shown in Appendix B. Sample item No. 1 required the subject to indicate if the picture illustrated a correctly functioning sound motion picture projector. Four answers were possible for this item. Three answers required the subject to indicate if the projector was improperly threaded, improperly adjusted, or both improperly threaded and adjusted. Sample item No. 2 required the

student to indicate if the three pictured operations were presented in the proper sequence. The answer was either yes or no. Sample item No. 3 required the student to indicate if the projector was properly threaded and adjusted to rewind a film. This question was also answered yes or no.

The answers were written on the answer sheet (Appendix C) which was arranged so that the answers and other information could be coded on punch cards for analysis. Part IV of the test required the subject to write the names of the parts indicated. This part of the test was not directly related to the main study. The data was collected however to be analyzed to find how much incidental learning of nomenclature occurred as a result of the training. The experiment was conducted over a number of school terms. Data for some 250 individuals was collected. The test was given as a pre-test and as a post-test to approximately 110 subjects of which 98 proved usable.

The pictorial test was timed for Parts I, II and III on the assumption that the range of scores would indicate both the accuracy and speed of perception of the subjects. The time for Part I was six minutes, for Part II three minutes, and for Part III two minutes. Part IV was not timed. The subjects were given the option of writing a descriptive term if they did not know the technical name.

After pre-testing, students were given the criterion check sheet and trained with the understanding that the check sheet would be used for their final performance test. The subjects therefore knew their behavioral objectives. Subjects were scheduled for their individual performance tests within a period of one week. As close as practical to the middle of the week in which the criterion performance test was being administered, the pictorial test was given as a group test within the regular classroom.

TABLE I

CORRELATION BETWEEN WRITTEN VERBAL-PICTORIAL (VP) TEST SCORES AND PERFORMANCE (P) TEST SCORES

	N	$\bar{X}$ (VP)	σ(VP)	$\bar{X}$ (P)	σ(P)	r
Males	30	42.50	5.96	77.73	5.11	-.02
Females	68	40.54	6.30	76.41	4.51	.22
Total	98	41.14	6.23	76.96	4.70	.16

The correlation between the written verbal-pictorial test scores and the performance test scores is .16 for 98 subjects. Hypothesis 1 must therefore be rejected. A r of .16 is not significant at the .1 level for 96 (N-2) degrees of freedom. Considering females only, however, the r is significant beyond the .05 level.

Hypothesis 2 was stated as follows: There will be a significant difference between the means of the verbal-pictorial paper and pencil test scores when administered as a pre-test and as a post-test to the same individuals. Table II gives the means, standard deviations and t for 98 subjects pre-test and post-test scores.

TABLE II

CORRELATED t TEST BETWEEN THE MEANS OF THE PRE-TEST (PRT) AND POST-TEST (POT) SCORES

	N	$\bar{X}$ (PRT)	σ (PRT)	$\bar{X}$ (POT)	σ (POT)	t
Males	30	30.33	6.73	42.50	5.96	10.10
Females	68	27.71	6.47	40.51	6.30	14.38
Total	98	28.51	6.63	41.14	6.23	17.59

The t test between the means of the pre-test and post-test scores is 17.59 for 98 subjects. This is significant beyond the .001 level. Hypothesis 2 is therefore retained.

SUMMARY

In some instances, large numbers of students are required to learn how to operate basic audiovisual equipment. Because of the great amount of time needed to evaluate each student individually the need for a group test is indicated. A verbal-pictorial test based on the Bell and Howell Model 385 motion picture projector was developed as a pilot project to determine the feasibility of such an undertaking. Black and white still photographs, printed in booklet form, were used for the test. Students vere verbally cued to a pictorial test which required them to perceive the projector as either threaded or adjusted correctly. Additionally they were required to visually identify the correct sequence for operating the projector. They were also required, if possible, to list the nomenclature of the most important parts of the projector. The verbal-pictorial test scores were correlated with scores on a criterion performance check sheet. Because the test was given as a pre-test and post-test to some subjects, it was also possible to calculate a correlated t test of the difference between the means.

The correlation between the verbal-pictorial test and the criterion check sheet scores was positive but low ($r = .16$). If males and females are considered separately the correlation is higher for the females than for the males. The t test between the means of the pre-test and the post-test yield a t of 17.59 ($p < .001$).

CONCLUSIONS AND SPECULATIONS

The conclusion which seems warranted from this study is that verbal-pictorial tests are not, at this time, a practical substitute for individual observer scoring of motion picture projector operation performance. This finding tends to follow Williams implied conclusion that the results of his verbal-pictorial test were unstable. The results are in variance with results of the Navy study described by Cronbach and the conclusions of Lefkowith.

This writer speculates that motivation, or its lack, played a great part in the negative correlations between verbal-pictorial test scores and criterion performance test scores in the case of the male students. Subjects of this study were told they were taking part in an experiment and that the results of the pictorial test would in no way affect their course grade. This is, on the face of it, the worst possible situation for motivation with college students. Additionally, scores on the criterion performance check sheet were probably compressed because the students knew they were required to receive a minimum score of 59 of the possible 80 or retake the test.

The following recommendations are offered to researchers for further studies of pictorial testing procedures.

1. Item formats should be studied in more detail.
2. Attention should be given to subject motivation.
3. An attempt should be made to develop very sensitive criterion tests which will yield a wide range of scores.
4. Time should be taken into consideration when weighing test results as this is a factor in efficient operation of equipment.
5. Verbal-pictorial training should be given to subjects to determine if they can make acceptable scores on the verbal-pictorial test without having actually operated the equipment.
6. The ability to transfer knowledge is most important to the educated teacher. Therefore, the ability to transfer the learning from one machine to another should be investigated.

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APPENDIX A

Southern Illinois University
IM 417 Laboratory

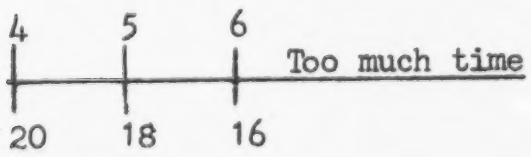
MOTION PICTURE PROJECTOR PROFICIENCY EXAMINATION

Steps Completed in Projection of Film

1.	Clean projector (use brush)	(4) Correct	(1) Incorrect	(0) Forgot
2.	(a) Check forward-reverse switch	(4) OK		(0) Forgot
	(b) Check sound-silent switch	(4) OK		(0) Forgot
	Prefocus			
3.	Turn motor and lamp on (in that order)	(5) In order		(0) Not in order
4.	Center and focus image on screen	(2) OK focus		(0) Did not prefocus
5.	Check sound apparatus before projection	(4) OK		(0) Forgot
6.	Turn volume down to "0" after checking sound apparatus (leaving amplifier on)	(4) OK	(2) Sound up	(0) Sound off
	Threading			
7.	Thread film properly	(5) OK		(0) Wrong
8.	(a) With correct loop length	(4) Loop correct		(0) Loop incorrect
	(b) Have film tight around sound drum	(4) Film tight		(0) Film loose
	(c) Advance film to title frame and stop	(2) Correct		(0) Forgot
	Projecting			
9.	Turn on machine, then turn on lamp at beginning of film	(4) OK	(2) Light on too soon or too late	
10.	Fine Focus (if necessary)	(4) OK	(1) Late focus	(0) Out of focus
11.	Set volume at reasonable level	(4) Volume OK	(2) Too much/ Too little	(0) No volume
12.	Frame picture (if necessary)	(4) OK		(0) Not OK
13.	#10,11, & 12 in sequence	(6) Correct order		(0) Incorrect
14.	Turn off lamp at end of film (before motor is stopped)	(6) Correct order		(2) Incorrect
15.	Turn off amplifier	(4) OK		(0) Forgot
16.	Rewind properly	(4) OK	(1) Ask for help	(0) Wrong
17.	Unplug	(2) OK		(0) Forgot

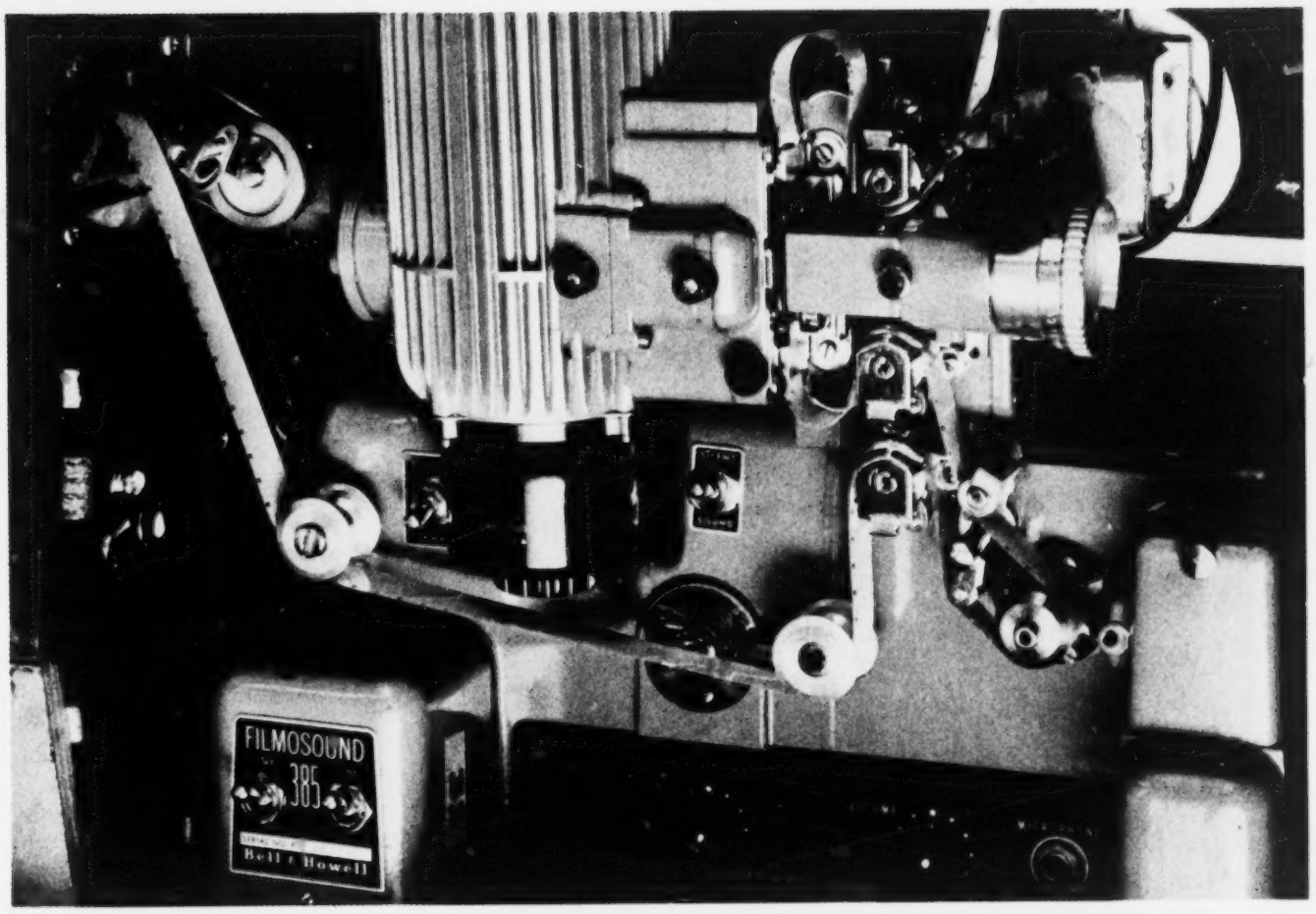
TOTAL POINTS _____

TOTAL TIME MINUS FILM TIME



APPENDIX B
Sample Items

No. 1



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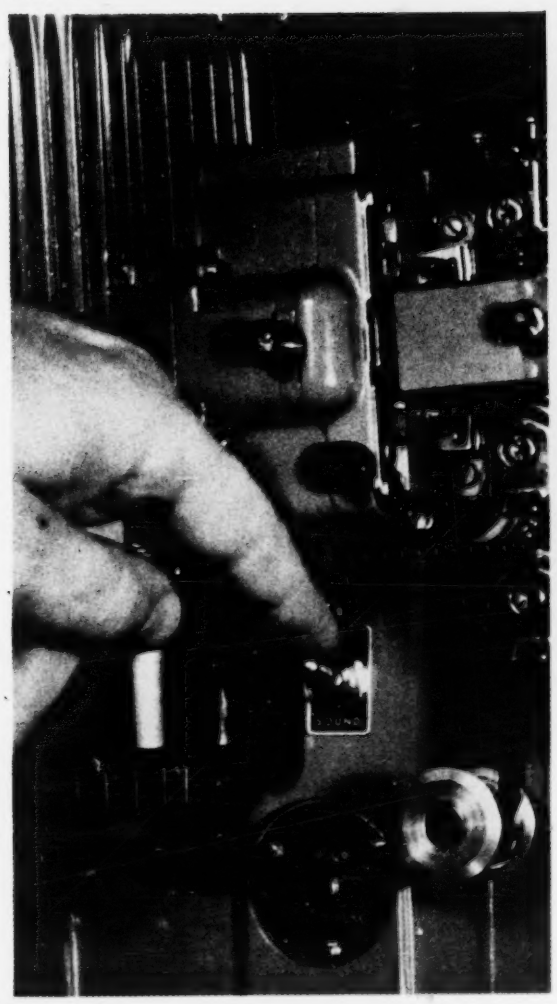

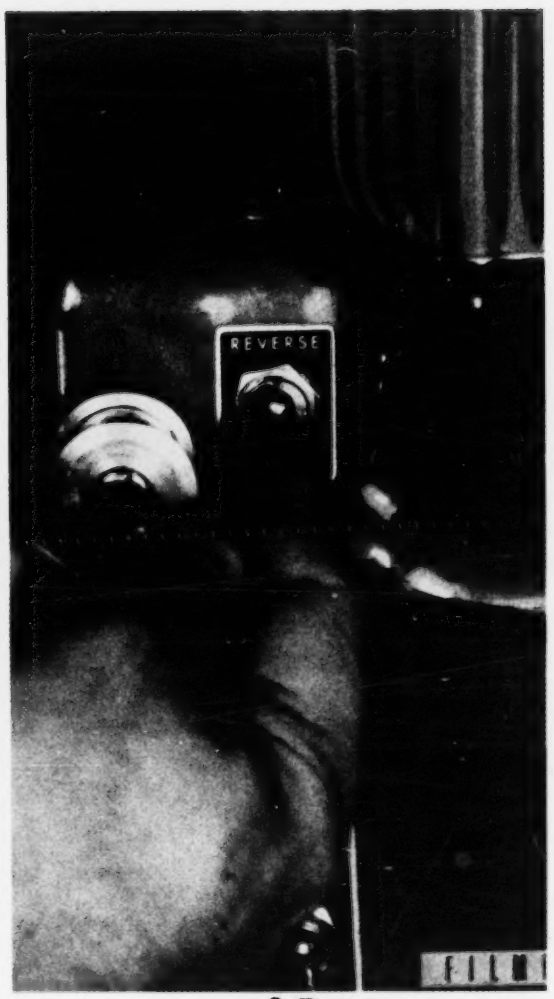

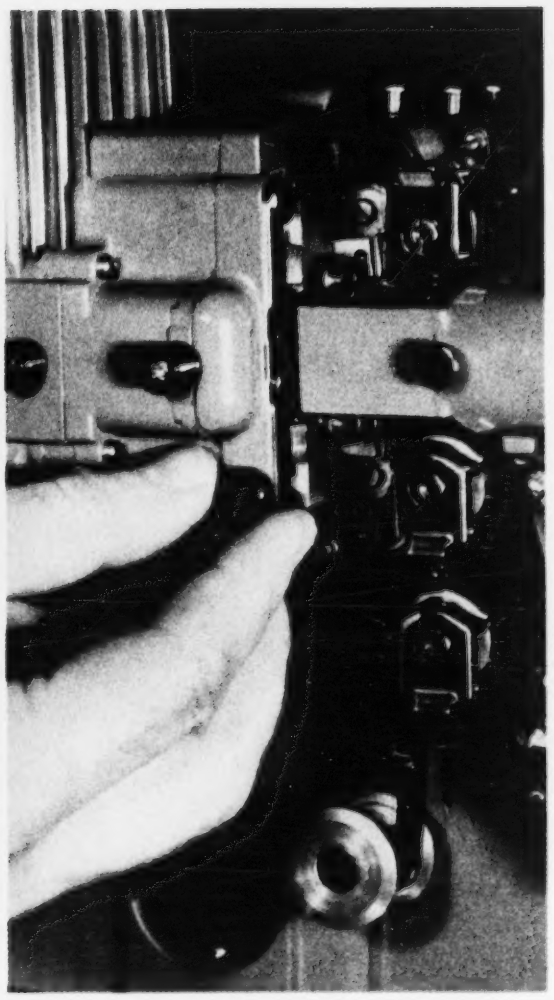

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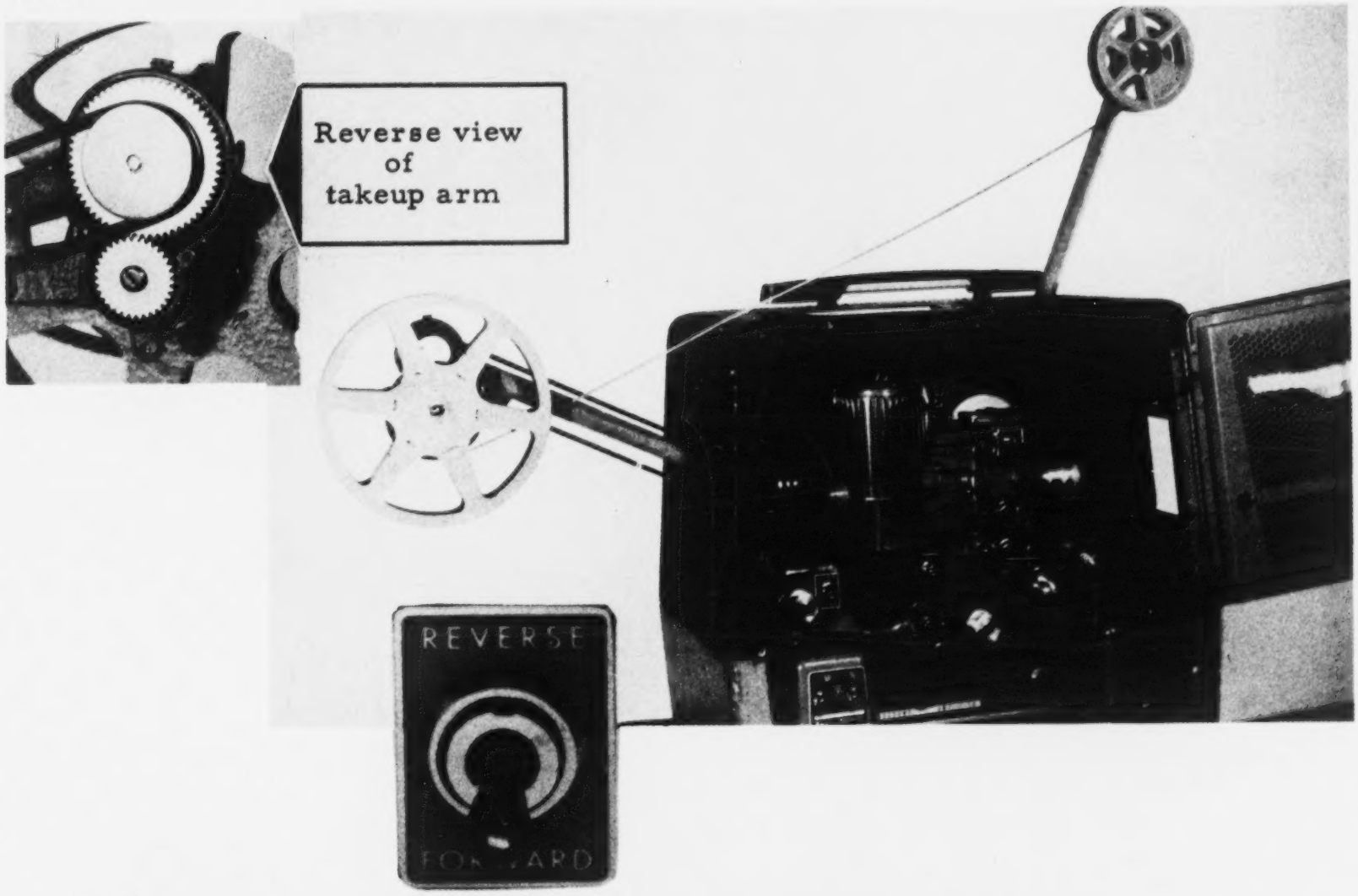

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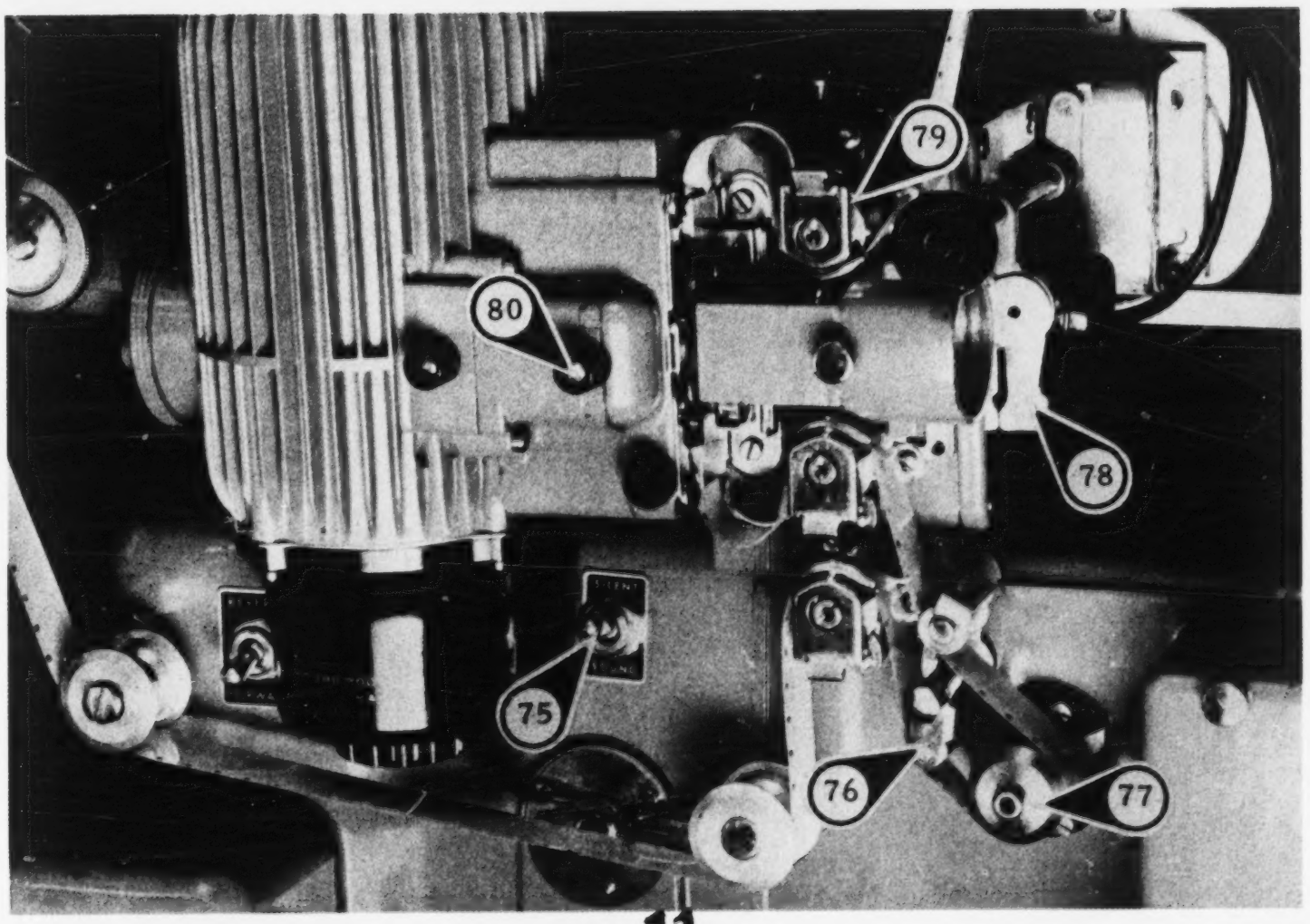

APPENDIX C

BELL & HOWELL PROFICIENCY TEST ANSWER SHEET

Name_____ Sex_____ Class Standing_____

General Information

1. Number of hours practice on Bell and Howell 385 projector
   (Circle one) 0 1 2 3 4 5 or more

2. Number of hours formal training on a Bell and Howell 385 projector.
   (Circle one) 0 1 2 3 4 5 or more

3. Number of hours practice on any other projector. (specify)_____
   (Circle one) 0 1 2 3 4 5 or more

PART I

Sample

1 2 3 4 5 6 7 8 9 10 11

12 13 14 15 16 17 18 19 20 21 22

23 24 25 26 27 28 29 30 31 32 33

PART II

Sample

40 41 42 43 44 45 46 47 48

49 50 51 52 53 54 55 56

PART III

61 62 63 64 65 66 67 68

75. Sound-silent switch

76. _____

77. _____

78. _____

79. _____

80. _____

81. _____

82. _____

83. _____

84. _____

85. _____

86. _____